

REMARKS

Applicant wishes to thank the Examiner for the attention accorded to the instant application, and respectfully requests reconsideration of the application as amended.

Claims 1-8 and 20-34 are pending in the application. Claims 1, 20, 29 and 34 are amended. Specifically, the limitation that “an upper portion of the first region being oxidized or hydroxylated to form the catalyst supporting portion”, is added to Claims 1, 20 and 34. Support for this amendment can be found throughout the specification, for example, on page 31. Claim 34 has been amended to list the steps starting at (a).

Objection to the Claims

Claims 20 and 29 have been amended in response to the Examiner’s objections. In Claim 20 line 19, “a” has been substituted with “the” as proposed by the Examiner. In Claim 29 line 3, “are” has been substituted with “is” as proposed by the Examiner. Thus, it is respectfully requested that the objection of Claim 20 and 29 be withdrawn.

Rejection of Claims Under 35 U.S.C. §102

Claims 1, 3-4 and 20 are rejected under 35 U.S.C. §102(b) as being anticipated by Lee et. al., European Patent No. EP1061043A1 (hereinafter “Lee”). This rejection should be withdrawn based on the comments and remarks herein.

The present application teaches a catalyst supporting substrate which includes a first region which is formed on a substrate and a second region formed over the first region (Page 5 lines 1-3), the first region contains a first material, the upper portion of which is oxidized or hydroxylated to form the catalyst supporting portion (Page 5 lines 3-5 and Page 6 lines 1-4), the first material includes a metal containing at least one of the elements selected from the second group to the fourteenth group of the periodic table or a compound thereof (Page 5 lines 7-10), the

second material is a catalyst which grows carbon nanotubes in a vapor phase (Page 5 lines 10-12).

As amended, all of the independent claims, e.g. claims 1, 20 and 34, recite “an upper portion of the first region being oxidized or hydroxylated to form the catalyst supporting portion.”

Lee discloses a first region formed on a substrate, a second metal catalyst layer being formed of cobalt, nickel, iron or an alloy of the same, over said first region, which grows carbon nanotubes in a vapor phase (Paragraphs 13-15). Lee does not disclose oxidation or hydroxylataion of a portion of the metal film or catalyst layer which is placed over the substrate. Claims 1, 3-4 and 20 now include this limitation.

Claims 1, 3-4 and 20 are not anticipated by Lee and are patentably distinguishable over this art. Further, the dependent claims incorporate the features and limitations of their base claims, so that these dependent claims are not anticipated by Lee, and are patentably distinguishable over this art.

Rejection of Claims Under 35 U.S.C. §103

Claims 2, 5-8, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Coll et. al., U.S. Patent Application Publication No. 2003/0042226 (hereinafter “Coll”). Claims 22-23, 25-29, 31-32 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Brandes et al., U.S. Patent No. 6,445,006 (hereinafter “Brandes”). Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Resasco et. al. U.S. Patent Application Publication No. 2005/0042162 (hereinafter “Resasco”). Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view

of Brandes, in further view of Coll. Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Brandes, in further view of Resasco.

As discussed above, Lee does not disclose an upper portion of a first region being oxidized or hydroxylated to form a catalyst supporting portion, as recited in independent claims 1, 20 and 34, and all claims depending therefrom.

Coll teaches a method of forming a nano-supported sponge catalyst on a substrate. The sponge catalyst is comprised of a mixed metal alloy layer of active catalytic metallic element nano-particles and a structural metallic element (Paragraph 12). The alloy layer is etched to remove material, forming pores through the structural metallic element, and to oxidize both the active catalytic metallic element nano-particles and the structural metallic element (Paragraphs 19-20).

The Coll application teaches the etching of the mixed metal alloy film to at least partially remove and selectively oxidize the structural metallic element (Paragraph 19). Coll further teaches that the etchant targets the structural metallic element because it is the most electrochemically active, providing partial removal and selective oxidation of the structural metallic element (Paragraph 19). The Coll application teaches that this selective removal of the structural metallic element will increase the surface area to volume ratio (Paragraph 23). Increasing the surface area to volume ratio increases reactivity by allowing more catalyst to be accessible within the structural metallic element (Paragraph 23).

Oxidation in the present application is used for a much different purpose, leaving no motivation for one of ordinary skill in the art to combine the Lee and Coll references. In the present application, initially a metal film is formed on a substrate, then the upper portion of that film is oxidized to form the catalyst support layer, with the lower portion of the film becoming a

foundation layer, a catalyst layer is then formed over this now oxidized metal film. This method increases the adhesive property of the metal film to the substrate and the patterning property of the catalyst containing film, as described on page 24 of the application. This method also increases the yield, adhesion and electrical property of the carbon nanotubes as described on page 25 and 26 of the application.

A person of ordinary skill in the art, trying to increase the yield, adhesion and electrical property of carbon nanotubes, and increase the adhesion of a metal film to a substrate would not look to combine the teaching of Coll with Lee.

Further, as amended Claims 1, 20 and 34 of the present application claim oxidation or hydroxylation of an upper portion of a first material to form a catalyst supporting portion. Oxidation of the upper portion of the first material forms the catalyst support, over which a catalyst film is formed, which is referred to as the second region in Claims 1, 20 and 34. In Coll, the catalyst is dispersed throughout the mixed metal alloy film, and through the entire vertical distance of the nano-supported sponge catalyst. Coll does not teach or suggest the formation of a catalyst film on a first region.

Therefore, the hypothetical combination of Coll with Lee would not render the device of the present application. Lee fails to teach or suggest an upper portion of a first region being oxidized or hydroxylated to form a catalyst supporting portion, with the oxidation step in Coll forming a sponge region by removing material from an upper portion. The combination of Coll with Lee would render a sponge layer which had undergone oxidation and is able to form carbon nanotubes without a further catalyst addition, not an upper portion of a first region which is oxidized or hydroxylated to form the catalyst supporting portion, onto which a catalyst is formed before carbon nanotube growth. Also the catalyst in the present application undergoes

deoxidation before growth of carbon nanotubes, which is not taught or suggested by either the Coll or Lee reference.

Thus, the hypothetical combination of Coll and Lee would not result in or suggest a catalyst supporting substrate comprising; a first region which is formed on a substrate, the first region including a catalyst supporting portion containing a first material, the first material including a metal containing at least one of elements selected from the second group to the fourteenth group of the periodic table or a compound thereof, an upper portion of the first region being oxidized or hydroxylated to form the catalyst supporting portion, and a second region which is formed covering a part of the first region, the second region including a catalyst portion containing a second material which is different from the first material, the second material is a catalyst which grows carbon nanotubes in a vapor phase.

None of the additional art cited by the Examiner overcomes these deficiencies of Coll, and the Examiner does not suggest otherwise. The Examiner only used the Coll reference to teach oxidation of a film. This rejection should be overcome by the amendments and arguments above. The addition to each of the independent claims of the described limitation should overcome the other rejections because all claims in the present application will contain the limitation of a metal film which contains a first material and is formed on a substrate, and a catalyst supporting portion includes a film that an upper portion of the metal film is oxidized or hydroxylated.

In addition, the Brandes and Resasco references also do not overcome the deficiencies of Lee.

Brandes teaches growing carbon nanotubes in the direction along a surface of the catalyst support substrate by application of an electric field at a predetermined direction. This

description of affecting direction of growth for the carbon nanotubes occurs in the first two paragraphs Column 6, and the sixth paragraph of Column 8. Brandes does not teach oxidation of a metal film and formation of a catalyst film over the metal film.

Resasco teaches treating the surface of a catalyst with a reducing gas before growth of carbon nanotubes. Resasco describes this in paragraph 25-26 and Claims 11, 64 and 71. Resasco does not teach oxidation of a metal film and formation of a catalyst film over the metal film.

Accordingly, the art of record in the application does not teach or suggest each and every feature of the present invention as recited in the independent claims.

Thus, it is respectfully requested that the rejection of Claims 2, 5-8, and 21-34 under U.S.C. §103(a) be withdrawn.

For at least the reasons set forth in the foregoing discussion, Applicant believes that the Application is now allowable, and respectfully requests that the Examiner reconsider the rejection and allow the Application. Should the Examiner have any questions regarding this Amendment, or regarding the Application generally, the Examiner is invited to telephone the undersigned attorney.

Respectfully submitted,



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